MinnesotaCorn RESEARCH & PROMOTION COUNCIL

PROGRESS REPORT

PROJECT TITLE: Dialing in the Most Corn-Profitable and Environmentally Responsible Nitrogen Rate
PROJECT NUMBER: Award CON000000111812; Project 00115482
REPORTING PERIOD: January to March 2025
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1.) PROJECT ACTIVITIES COMPLETED DURING THE REPORTING PERIOD. (*Describe project progress specific to goals, objectives, and deliverables identified in the project workplan.*)

The objectives of this study are to conduct a comprehensive study measuring the effect of various nitrogen rates on: 1) corn grain-yield, 2) economic return, 3) nitrogen use efficiency of corn, 4) nitrate leaching load in tile-drained fields, 5) nitrous oxide emissions, and 6) ammonia volatilization. An additional objective is to translate the information generated through this study into usable knowledge that can benefit Minnesota corn growers and society (including data for the MRTN calculator and generation of data to inform other models or tools that may become available).

Below is a list of activities done during the quarter:

January:

- Interacted with participants at the Minnesota AgExpo and discussed the project
- Processing and analyzing plant, soil, gas, and water samples
- Calibrating flow meters for drainage pits to be reinstalled this spring
- Review data for outliers and begun analyzing the data

February:

- All supplies were ordered for the upcoming field season
- Worked on cleaning and analyzing the data
- Writing of dissertation by Zac Aanerud and reviews by PI. Both still on-going

March:

- Checked the N2O analyzer to ensure proper functioning in preparation for the growing season
- Worked on analyzing the data and interpreting results

- Writing of dissertation by Zac Aanerud and reviews by PI. Both still on-going

2.) IDENTIFY ANY SIGNIFICANT FINDINGS AND RESULTS OF THE PROJECT TO DATE.

Figure 1 shows the grain yield response to nitrogen rate for the last four growing seasons. The 2021 and 2022 growing seasons were impacted severely by drought, which was the limiting factor for crop growth and yield. The dry conditions also resulted in minimal N loss through nitrate leaching (Figure 2). The actual nitrate load averaged across N rates was only 2 lb NO_3-N/ac in 2021 and 5 lb NO_3-N/ac in 2022. The 2023 growing season had periods of drought, especially later in the summer that also limited the yield potential of the crop, but because of a wet spring, the dry soil from the previous seasons was able to recharge and the stored moisture helped the crop to continue to grow for the early part of the summer. However, N loss due to above-normal precipitation in the spring resulted in higher N loss than the previous two growing season (Figure 2). The actual nitrate load averaged across N rates was 44 lb NO_3-N/ac (range of 11 to 82 lb NO_3-N/ac across N rates) and resulted in higher economic optimum N rate (EONR). The last growing season was the most contrasting of the study so far. In 2024 we had excessive precipitation well into the first part of July. This created challenges for getting the crop established and growing, but this field since it was tiled, was able to do better than other adjacent fields with insufficient tile drainage. The excessive precipitation also resulted in high N loss through leaching, similar to 2023. The actual nitrate load averaged across N rates was 38 lb NO_3-N/ac (range of 4 to 72 lb NO_3-N/ac across N rates). Starting in mid-August the weather turned hot and dry and resulted in lower yield potentials because the grain did not fill completely. While we did not measure root development, the wet conditions early in the season probably limited root growth deep in the soil, and when the soil dried up in August, the roots were not able to use water deeper in the soil profile. None the less, the yield at the EONR was 200 bu/ac. The amount of N needed to achieve the EONR was higher than typical, likely reflecting N loss that happened earlier in the season.

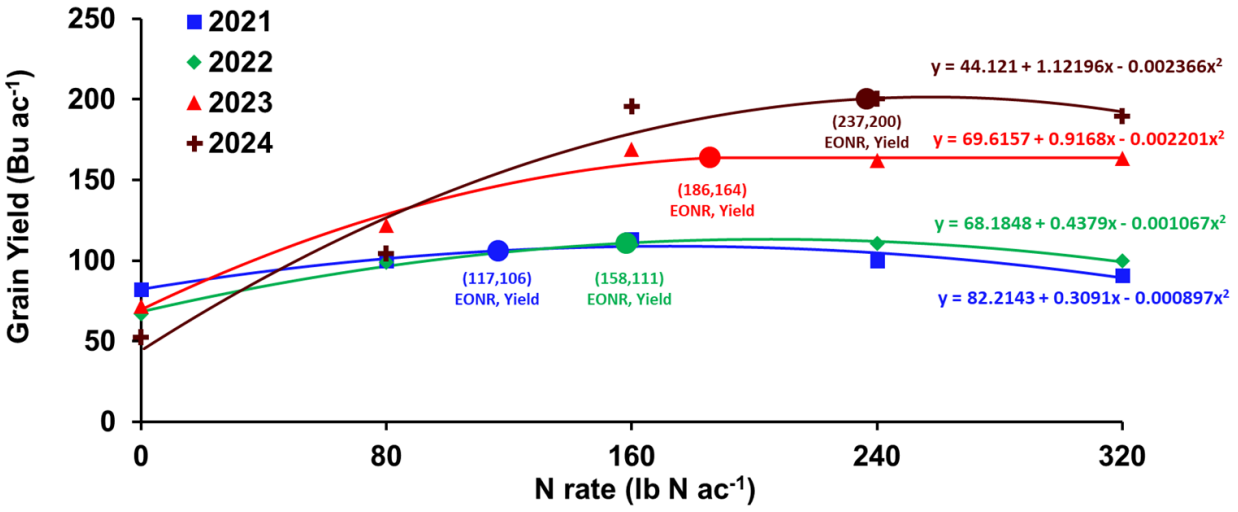

Figure 1. Corn yield response to nitrogen rate across years.

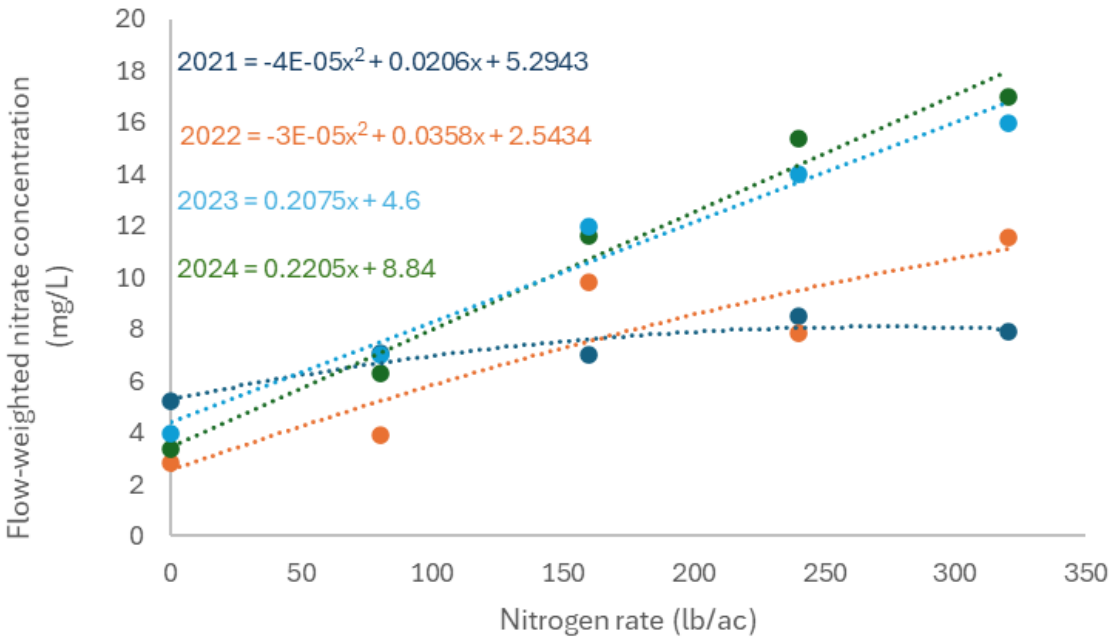

Figure 2. Flow-weighted nitrate concentrations in response to nitrogen rate across years.

3.) CHALLENGES ENCOUNTERED. (*Describe any challenges that you encountered related to project progress specific to goals, objectives, and deliverables identified in the project workplan.*)

We had several slow-downs in getting samples analyzed chemically due to personnel availability and lab/equipment issues.

4.) FINANCIAL INFORMATION (*Describe any budget challenges and provide specific reasons for deviations from the projected project spending.*)

None to report

5.) EDUCATION AND OUTREACH ACTIVITES. *(Describe any conferences, workshops, field days, etc attended, number of contacts at each event, and/or publications developed to disseminate project results.)*

Some of the results from this research site were presented during the Minnesota AgExpo, Nitrogen Conference, Research Updates for Ag professionals, and a couple of county level extension meetings.